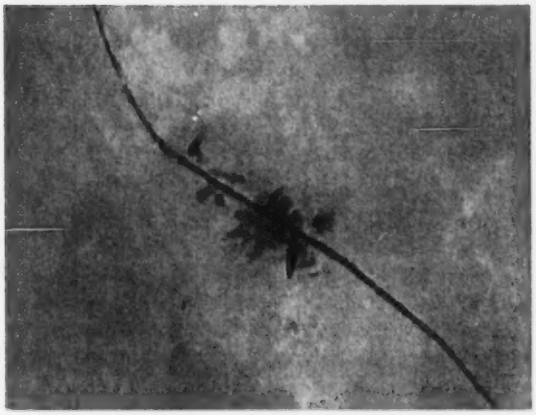
Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Central and Arctic Region
Canadian Science Advisory Secretariat
Science Advisory Report 2011/024

REVIEW OF AERIAL SURVEY ESTIMATES FOR RINGED SEALS (*Pusa hispida*) IN WESTERN HUDSON BAY, 2009 AND 2010



Ringed Seals hauled out along crack in sea ice in western Hudson Bay as observed from survey aircraft.(photo credit: J. Blair Dunn)

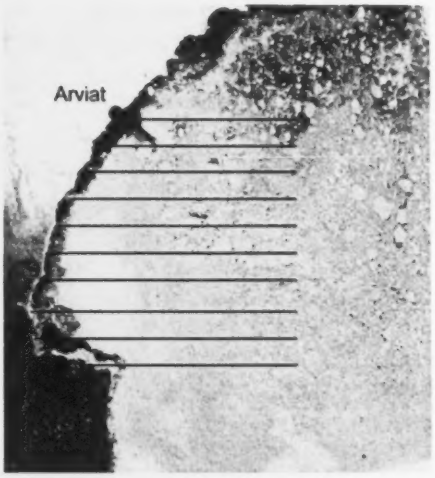


Figure 1. Satellite photo of western Hudson Bay taken 5 June 2010 showing ice cover at the start of the aerial survey and survey lines. (NASA/GSFC, MODIS Rapid Response. http://rapidfire.sci.gsfc.nasa.gov/).

Context:

Ringed Seals (Pusa hispida) are the main food resource for Polar Bears (Ursus maritimus) and contribute the bulk of the Inuit subsistence harvest of marine mammals. Periodically, Fisheries and Oceans Canada (DFO) receives inquiries about the feasibility of establishing a commercial hunt in Nunavut. However, little information is currently available to assess the potential impact of such an activity in Hudson Bay. Development of an Integrated Fishery Management Plan for Nunavut Ringed Seals is planned.

This Science Advisory Report is in support of a request for science information from DFO Fisheries Management.

SUMMARY

- Results of two aerial surveys in 2009 and 2010 indicate that the relative density of Ringed Seals in western Hudson Bay falls in the range of densities estimated in previous years and within estimated densities for other areas in the Canadian Arctic.

- Combined with past western Hudson Bay survey estimates, the 1995-2010 data series of identical survey coverage suggest a declining trend in Ringed Seal density although not significant. A major source of uncertainty in the density estimates is associated with annual variation in movements of sea ice and pattern of ice melt during the period when seals are hauled out moulting.

- Ringed Seals are a good indicator species of long-term changes occurring in the Arctic marine ecosystem because of their dependence on sea ice for reproduction and survival.

- Due to changing sea ice patterns associated with warming temperatures, it is recommended that the area be re-surveyed in three years to reassess changes in seal density.

INTRODUCTION

Rationale for assessment

Considered to be an indicator species for Arctic environmental change, the evolutionary adaptations of Ringed Seals to exploit sea ice habitat for reproduction and survival could expose this species to critical challenges with global warming and subsequent loss of sea ice. Despite its low-latitude position, the input of Arctic waters makes Hudson Bay an Arctic ecosystem. Marine mammals inhabiting Hudson Bay either year-round or seasonally include five species of pinnipeds and four species of cetaceans. Hudson Bay is warming faster than the global rate due to snow and ice albedo feedbacks, and increased warming is responsible for a reduction in sea-ice extent and snow cover and the lengthening of the ice-free season.

Sea-ice dependent species will be impacted by habitat loss and a possible increase in predation and competition with temperate species. As a result Ringed Seals are expected to change distribution, condition, reproduction, and ultimately survival and abundance. Evidence of such changes has been reported in Hudson Bay for ice-associated Thick-billed Murres (*Uria lomvia*), Arctic Cod (*Boreogadus saida*), Capelin (*Mallotus villosus*), Polar Bears (*Ursus maritimus*), Harbour Seals (*Phoca vitulina*), Harp Seals (*Phoca groenlandica*), Bearded Seals (*Erignathus barbatus*), and Ringed Seals.

Evidence for possible declines in Ringed Seal survival and reproduction in western Hudson Bay from the 1990s has been indicated by reduced pregnancy rate, reduced pup survival and recruitment, later age of maturation, older age structure, and declining abundance. Research conducted in the 2000s assessed whether Ringed Seal demography improved over the 1990s condition. Results indicated positive demographic indices for the 2003-06 period with higher pregnancy rate, higher pup survival, earlier age of maturity, and younger age distribution (Vincent-Chambellant 2010). However, western Hudson Bay Ringed Seal abundance declined from 2007 to 2008 (Chambellant and Ferguson 2009) necessitating the need for surveys in 2009 and 2010 to assess recent changes (Ferguson and Young 2011).

Species biology and ecology

The Ringed Seal is the smallest phocid and is restricted to a northern circumpolar distribution with the Hudson Bay population occurring at the southern limit of the species' range. Stable land-fast ice with >20 cm snow cover and ice deformities supports critical Ringed Seal mating, parturition, and nursing habitat. Hudson Bay Ringed Seal pups are born in March-April and the ice platform is critical for their pre- and post-weaning survival. Breeding is thought to occur after

weaning and precedes the annual moult in June when Ringed Seals haul-out on sea ice. Ringed Seals of all ages in western Hudson Bay feed primarily on Sand Lances (*Ammodytes* sp.) particularly during the open-water season. Ringed Seals are the main prey of Polar Bears and are hunted for subsistence by Inuit communities located around Hudson Bay.

ANALYSIS

The study area (84,450 km^2) represents about 10% of the entire shallow marine system (mean depth 150 m) of western Hudson Bay, Canada (Figure 1). The bay is ice covered from November to June when break-up occurs and is completely free of ice during the summer and early fall months. Coastal leads are present throughout the ice-covered season and include a large persistent lead along the west coast of Hudson Bay. The study area encompassed a zone from Churchill, Manitoba (58°45'N; 94°3.6'W), in the South and Arviat, Nunavut (61°6'N; 94°4.2W), in the North, and from the shoreline to the West, and to 89°W of longitude offshore to the East. The area surveyed was dominated by moving ice with floes of different sizes, whereas landfast ice represented only about 2% of available sea ice.

Two aerial surveys in western Hudson Bay in June 2009 and 2010 consisted of four and ten lines, respectively. The survey protocol was designed following Lunn et al. (1997) and analyses were conducted using strip-transect analysis. Ringed Seal relative density estimates reported in this study (Table 1) are in general agreement with past results (0.28 to 1.22 seals/km^2) and studies in the Arctic (range 0.19 to 1.16 seals/km^2). Density on the landfast ice is generally greater than Ringed Seal density on moving ice.

Table 1. Ringed Seal relative density and abundance estimates and associated variability estimated using strip-transect analyses from data collected by two observers during aerial surveys of Ringed Seals on ice in western Hudson Bay, 2009 and 2010. The 2009 survey was not complete and covered only 40% of the study area. Density estimates reported here are for the entire survey area whereas previous results calculated seal density only over available sea ice (Lunn et al. 1997; Chambellant and Ferguson 2009).

	Density (seal/km^2) [1]	95%CI [2]	Abundance+SE	95%CI	%CV [3]
2009	0.28±0.049	0.23-0.33	23,458±2,288	19,385-28,386	35.5
2010	0.73±0.061	0.62-0.86	62,157±5,344	52,533-73,543	11.8

[1] Estimated parameter ± SE (standard error).
[2] Log-based confidence interval at 95% level of significance.
[3] Percent coefficient of variation.

Density estimates for Ringed Seals varied greatly from 2009 to 2010 in western Hudson Bay. Results from the 2009 survey should be viewed with caution as poor weather and deteriorating ice conditions limited the survey coverage to 40% of the area. Inter-annual variation in the density of Ringed Seals hauled-out on the ice has been commonly reported in the literature (Chambellant 2010). Density and abundance estimates presented in this study are an underestimate due to seals missed by visual observation and seals missed due to unavailability (i.e., in water). The complete time-series dataset, from 1995 to 2010, suggests a possible decline.

Sources of uncertainty

A major source of uncertainty in the density estimates is associated with annual variation in movements of sea ice and pattern of ice melt during the spring survey period when seals are hauled out moulting. For example, seals may redistribute outside of the study area due to deteriorating ice conditions. Corrections are required to estimate seals missed by visual survey (i.e., relative to photographic survey), proportion hauled out, and seals diving due to plane noise.

CONCLUSIONS AND ADVICE

The relative density estimates found in this study are in the range of Ringed Seal densities estimated previously for this area and are within the expected range of densities estimated using similar methods at other locations in the Canadian Arctic. Trends in the time series of survey density estimates, from 1995 to 2010, suggest a possible overall decline. Previous studies reported demographic difficulties for Ringed Seals in western Hudson Bay in the 1990s; however recent data on demography suggests Ringed Seal condition returned to expected rates during the 2003-2006 period (Vincent-Chambellant 2010). A major source of uncertainty in the density estimates is associated with annual variation in movements of sea ice and pattern of ice melt during the spring survey period when seals are hauled out moulting. Given the accelerated changes in timing of spring sea ice break-up it is advisable to re-survey this area in three years to assess changes in seal density.

SOURCES OF INFORMATION

This Science Advisory Report results from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, National Marine Mammal Peer Review Committee Meeting (NMMPRC) of November 22-26, 2010. Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

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FOR MORE INFORMATION

Contact: Steven Ferguson
501 University Crescent
Winnipeg, MB, R3T 2N6
Tel: 204-983-5057
Fax: 204-984-2403
E-Mail: steve.ferguson@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Central and Arctic Region
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, MB
R3T 2N6

Telephone: (204) 983-5131
Fax: (204) 984-2403
E-Mail: xcna-csa-cas@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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